

Mecheleciv



Volume 24 December - 1965 No. 3



THE GEORGE WASHINGTON UNIVERSITY

DECEMBER 1965



Self-propelled Westinghouse undersea craft for world-wide charter service



It can explore, test, salvage and sample the ocean floor—4,000 feet down

Westinghouse has built a remarkable undersea exploration craft called *Deepstar 4000*.

It can dive to a depth of 4,000 feet without cables. It can rise, turn, back up at will. It is self-propelled and inde-

pendent of surface craft while submerged.

Manned by a crew of three, the craft will explore the vast undersea world—sampling the ocean bottom, photographing specimens, setting and moni-

toring scientific instruments, salvaging lost cargo.

Deepstar 4000 is the first of a fleet of Westinghouse submersibles now being developed for depths up to 20,000 feet.

You can be sure if it's Westinghouse



For information on a career at Westinghouse, an equal opportunity employer, write L. H. Noggle, Westinghouse Educational Department, Pittsburgh, Pa. 15221.



IMPROVEMENT:

1954: Gross Sales = \$259,133,000

1964: Gross Sales = \$665,773,000

1974: Gross Sales = ?

We don't know the answer, but it will involve more **IMPROVEMENT.**

NCR always has been guided by the improvement concept: methods, quality, materials, people. That's why we hold professional seminars, provide advanced education, evaluate a man at regular intervals. We know that people must be ready for the next step up.

We know also that an employee's expectations from his work must be known and met.

What about you? Do you see a climate for self-improvement in your present job? If you are an engi-

neer's engineer, can you see the sometimes mythical "technical ladder"? If you are management oriented, is there room for you?

If you are a professional person with a minimum of a BS degree in Electronics, Mechanics, Chemical Engineering, Chemistry and research, development or manufacturing engineering background, write to us. See if we can meet your expectations.

By the way; we are interested in what you have done, but we are more interested in what you want to do! **IMPROVE?** Sure! You will have to, to stay up with NCR. Write to:

T. F. WADE
EXECUTIVE AND PROFESSIONAL PLACEMENT
THE NATIONAL CASH REGISTER COMPANY
MAIN & K STREETS, DAYTON, OHIO 45409

An Equal Opportunity Employer

N C R





CONSTRUCTION

THE ARMY CORPS OF ENGINEERS

offers you a challenging civilian career with:



■ The world's foremost and largest engineering organization in the construction field, pioneering new and advanced engineering practices and concepts

■ An organization whose work embraces virtually the entire range of modern engineering in the construction field. Projects include research into basic science, engineering investigations and regional planning; design, construction, operations, maintenance, and management of hydro-electric power dams, flood control facilities, harbors and navigable streams; design, construction and maintenance of family housing, runways, hangars, roadways, hospitals, and nuclear power installations, and construction of intercontinental ballistic missile and space launching sites. In addition are the allied fields of cartography, geodesy, mathematics, and engineer intelligence.



■ An organization that recognizes each engineer as an individual, providing well-rounded career development programs with on-the-job training, courses at government expense in colleges, universities, and seminars as necessary to assure steady progression to top professional and managerial levels; encouragement and assistance in attaining professional registration and recognition; and an opportunity to win national and international awards

■ An organization with offices and projects in nearly every one of the 50 States and in many foreign countries that encourages employees to further their development by accepting new and challenging assignments.

■ An organization which provides excellent rates of pay with liberal fringe benefits, including generous retirement annuity, complete health and life insurance coverage, paid vacation leave, military training leave with pay, generous sick leave, and special pay awards for outstanding performance and suggestions that improve operating efficiency

If you're thinking this is all too good to be true, you're wrong! All of the above is available to you in a civilian engineer career with the U. S. Army Corps of Engineers. If you are interested, you can get further information from the Chief of Engineers, Department of the Army, Washington, D. C. 20315

AN EQUAL OPPORTUNITY EMPLOYER

WRITE FOR AN ILLUSTRATED BROCHURE "YOUR CAREER."



**KEEP
OUT**

What's Tom Milling's secret?

The formula for the polymers for a unique new synthetic fiber. A fiber that might have a profound effect on more than one industry.

Tom is helping design a new process system for making the monomers—with Amoco Chemicals Corporation, our sister company. The system must be right, and right on time to meet an accelerating development deadline.

That may seem like quite an assignment for a 23-year-old chemical engineer. Less than a year from his B.S. at the University of Illinois. But not around here—at the Amoco Chemicals and American Oil Research

Centers. Since we're always after new and better products, we need the best men we can get. No matter how young they may be.

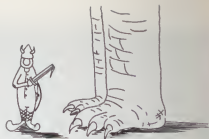
Which brings us to you. If some of today's technologies and products are starting to seem "old hat" to you, this may bring you to us. Your opportunity to learn new concepts and take part in new developments could be right here at American Oil. Whether you're in Chemistry, Mathematics, Physics, Electronics or Metallurgy.

Want more information? Write to J. H. Strange, American Oil Company, P.O. Box 431, Whiting, Ind.



AMERICAN OIL COMPANY

MOTIVATION NEEDED



"The primary motivation for learning must come from the student ...", is a hard hearted, soft headed attitude toward engineering education that finds an all too popular acceptance with many professors here at the George Washington University School of Engineering. It is, in my opinion, an extremely poor, if not tragic, philosophy of teaching.

The most important function of a teacher is not simply to answer questions and present a series of facts for the students to absorb like so many fuzzy, little sponges but to give the student a genuine interest in and liking for the subject matter. The primary motivation for learning should come from the teacher not the student. If a professor does not provide the motive force for a student to pursue his particular subject outside of the classroom and become vitally interested in the Engineering profession he has failed in his most important job.

The technical aspects of the engineering profession are changing at an unbelievable rate. Obsolescence of technical and scientific knowledge is not just a topic of essays but a reality, now. Today's graduate engineer will have to be able to understand the theoretical principle behind and application of new discoveries, be able to apply advanced mathematics and the scientific method to future problem solving and be motivated to continue learning.

Mr. T. Keith Glennan, president for 18 years of Case Institute of Technology, states the situation quite clearly in his article on Engineering Education in the November 20th Saturday Review. His opinion is that "... by the mid-Seventies the average engineer will have to spend the equivalent of one day per week in some kind of formal education, and the average Ph.D., in science or engineering will have to re-learn his degree every six or seven years to keep abreast of his field." "... we in education have not yet come to grips with the problem of motivation. How can we reinforce, as well as channel, the drive to learn? How can we enhance the desire for accomplishment and professional excellence?"

Pursuing an engineering education today is as easy as fighting a large green dragon with a bent sword and a hangover, and not nearly as exciting. Unless the student has some knowledge of the goals and tremendous personal rewards of the engineering profession it's difficult for him to see that it is worth the battle. Assuming that the average undergraduate, fresh from the high school prom, is going to be mature enough to dedicate himself to mastering all the theory he is exposed to is optimism carried to a new high in puerility. Granted, there will be a class of students who will strive for excellence on their own, but these individuals are few and far between and need little help from a professor. The average engineering student needs external guidance and motivation to develop the desire to enable him to realize his full potential.

Fortunately, there are those professors who, through some personality flaw, are willing to make the extra effort and spend the extra time to interest, stimulate and motivate their students. Professors Yoden, Moore, Braun, de Pian and Dedrick, to mention a few, all do more than simply present the material and answer questions. They (and the list is by no means inclusive) try to make the student understand the material they present as well as give application and extension of the theory. From these professors the student takes away not only a good fundamental knowledge of the material but a desire to learn more and someday, in the dim future, apply it to a practical problem.

It is hoped that other professors charged with the awesome task of educating future engineers will give some thought to the personal impact they have on the glassy eyed, little sub-humans, and through them on the future itself. If by his own interest in his subject matter and his profession he has planted in his students the desire to learn and become competent engineers, then he has done his job well and can be proud of his work.

EDITOR-IN-CHIEF
Millard E. Carr

ASSISTANT EDITOR
Donald Vespa

BUSINESS MANAGER
Norman Hess

page

EDITORIAL STAFF

TECHNICAL EDITORS
John Saunders
Thomas Dillon

EDITORIAL ASSISTANT
Judith J. Popowsky

PHOTOGRAPHY
Lee Young
Joseph Proctor

BUSINESS STAFF

ADVERTISING MANAGER
Donald Vespa

CIRCULATION MANAGER
Gordon Hoffman

ASSISTANT
Andy Kapust

ADVISORS

FACULTY
Dr. Louis H. Glassman

GRADUATE SCHOOL
Douglas Jones
Jerry L. Edwards
Rudolph Decatur, Jr.

ARTICLES

Educating Engineers for Management by Associate Professor Robert E. Cronin.	8
Basic Limitations of Radar and Sonar by Dr. Samuel J. Raff	12
Hydrostatic Bearings by Robert W. Alvarez	20
You Have Got To Be Kidding! by Judith J. Popowsky	27

DEPARTMENTS

Editorial	4
Letters to the Editor	6
Mech Miss	18
Tech News	23
Faculty Spotlight	25
Campus News	28
Theta Tau	29
The Shaft	32

COVER

This month's cover symbolizes the marriage between engineering and administration. May they live happily ever after.

Photo by Joe Proctor

**Member
 ENGINEERING
 COLLEGE MAGAZINES
 ASSOCIATED**

Chairman
Professor J. R. Bisset
Civil Engineering Department
University of Arkansas

**National Advertising
 Representatives**
Littell-Murray-Barnhill, Inc.
369 Lexington Avenue
New York 17, N. Y.

Published at the George Washington University by direction of the Engineers' Council. Published six times during the school year in October, November, December, March, April, and May. Second class postage paid at Washington, D. C. Address communications to Mecheleciv Magazine, Davis-Hodgkins House, George Washington University, Washington, D. C. 20006, or telephone 333-0173.

LETTERS TO THE EDITOR



Evidently there is someone who reads Mechelciv and either has a thought to convey or knows how to write. The two letters below, both received in the last few weeks, are evidence that someone does care.

The first of the two presents an opinion and the second offers agreement with last month's

editorial. Both are very welcome. It is hoped that anyone who is sufficiently pleased, angered or stirred by something appearing in this publication or who has a thought to offer will send his views to ye olde editor. It's hoped that this page can be a regular feature.

AN OPINION . . .

Dear Editor:

On the first floor of Tompkins Hall there is an area circumscribed by four walls and a door. Upon that door is a sign: DEAN. And inside that door is a potentate. From that potentate and out of that door come continual utterings about a lack of school spirit in engineering, about poor attendance at engineering functions, and about poor support for the various societies.

I don't want to call a good sovereign and potentate a hypocrite, but he has essentially forbid students to attend functions or meet together in organized groups. The open forums are lauded, but attendance is circumvented. The professional societies are criticized, but attendance is circumvented. Tau Beta Pi, Sigma Tau, and especially Theta Tau are assailed for lack of service, but nearly every effort to perform a service is circumvented.

The attendance and functioning of organizations is circumvented, not prohibited. Prohibiting these things would be considered despicable, but to indiscriminately send students to the Bureau of Standards or to class at all hours of the week is considered quite fair and proper by our potentates. To be specific: (1) the time honored Wednesday, 7:00 P.M. - 10:00 P.M. period which was reserved for meetings is now considered the same as any other time period; numerous complaints by responsible students are politely ignored. (2) So-called popular classes are not scheduled in the 5:30 P.M. - 7:00 P.M. period on Wednesday nights. (3) Students find themselves in school so many nights and traipsing out

to the Bureau of Standards so frequently that they are not going to consider making any special effort to be at G.W. for a meeting. JJP swears up and down that she and Chip Young have solved the problem, that engineering student organizations will no longer be circumvented via the schedule of classes; but then she has been swearing up and down for the past four semesters. In any event, engineering student organizations are currently circumvented, although not prohibited.

Perhaps, as Judy states, the problem has been solved. Perhaps our savants will receive this letter in the spirit of an honest critique, and thus contribute toward an honest effort to solve the problem. Or, perhaps a major upheaval in this day of idiotic demonstrations is needed to force a solution. Due to four known vindictive faculty members who could and would circumvent one's college career, the Engineers' Council can not be called upon to press hard for a satisfactory solution; indeed, only those very few students who are in their final semester and fortunately are not taking a class from one of the four vindictive faculty, can risk honest, open criticism of the administration. Thus, is the problem permanently solved? Will the schedule of classes aid or hinder student organizations? If the problem has not been solved, what is the best method of forcing a solution?

I would like to hear your comments, Mr. Editor, and I would like to hear the comments of the administration, the faculty, and other students.

Norman Seidle

AN AGREEMENT

Dear Mr. Carr:

I was somewhat surprised to read in your November issue that your March issue drew such a poor response - 2 letters in six months. Is this really so?

I ask, because in your October issue, I saw no "Letters-to-Editor Dept." or anything even vaguely similar. Does this mean you receive no comments or just that you don't print any letters?

In any event, concerning your Editorial in the Nov. issue, you hit on one of the basics of life with the words "do it, with all thy might", i.e. live. The rest, though very interesting - Mr. Lowe's paper offering much to think about -, is almost commentary.

So more commentary, maybe we can all learn something.

Very truly yours,
Burton R. Klein - T '65

THE MECHELECIV

FOR MANAGEMENT

by Robert E. Cronin

Associate Professor,
School of Engineering and Applied Science



have an important place in industrial², engineering, and scientific enterprises. The difference here is that in these latter fields, we find also the need for unique skills which relate to the industrial environment.

GRADUATE EDUCATION

Thus, engineering administration can emphasize the features of management which are specifically associated with industrial enterprises. Similarly, because students in a graduate program of engineering administration have received undergraduate degrees in engineering, physical science, or mathematics, they have available for their use, the techniques of quantitative analysis, mathematical models and operations research, which are important adjuncts of the scientific method of problem solving. These graduate students, being the product of engineering curricula at the undergraduate level, usually share a similarity of education and work experience, as well as a need for development of the specific managerial skills associated with industrial organizations. For these reasons it is appropriate and highly advantageous to utilize the problems of the factory, the engineering department and the laboratory, for case study and as practical supplements to the text material in management courses. In addition, faculty members who themselves have backgrounds in industrial organizations can enrich the learning experiences of these engineering students. Finally, if graduate study in engineering administration is to be provided for, it is logical for the regular faculty of an engineering school to engage in this activity, because of the advantages accruing to the students and to the institution through flexibility of faculty assignments in teaching and thesis advising.

MANAGEMENT EDUCATIONAL PROGRAMS FOR ENGINEERS

It is not surprising, then, to find that engineering schools in approximately twenty of our large universities are offering programs leading to graduate degrees in the management field. A recently completed survey indicates that the names of the Master's degree programs vary considerably, e.g., Engineering Administration, Industrial Management, Management Science, Industrial Administration, and Engineering Management. These are relatively new curricula, and generally are unrelated to those in the field of Industrial Engineering, which latter have been offered for many years.

One of the earliest of these programs is that of the School of Engineering and Applied Science of The George Washington University. Launched in 1954, with an initial enrollment of 175 students, the Engineering Administration program of this school has been expanded and kept current with modern thinking and concepts in engineering management. At present, approximately 375 students are registered in courses which are

part of their curricula leading to a Master's degree in Engineering Administration (M.E.A.). Seven members of the full-time faculty of this school are involved in course work and thesis advising in Engineering Administration. Their efforts are supplemented at present by the part-time activities of four members of the staff of instruction. An average of approximately forty Master's degrees have been awarded each of the past several semesters.

The requirements for admission to graduate study in Engineering Administration at this school are: a Bachelor's degree from a recognized institution, evidence of capacity for productive work in this field, an adequate knowledge of the principles of human relations and the fundamentals of statistics and accounting, and a working command of calculus. A program of studies (minimum, 24 semester-hours) is prescribed for each degree candidate. The candidate must submit an acceptable thesis and satisfactorily complete a comprehensive examination.

Here at George Washington, emphasis is placed on the scientific method of problem solving — the "method of the scientist." The aim is not to develop industrial engineers, analysts or programmers. Rather, it is to improve the engineer's understanding of the principles of administration as applied to industrial activities, and to increase his competence in the practice of this special field of management.

CONCLUDING OBSERVATIONS

It is difficult to conceive of an engineer "getting to the top" in this complex modern world without the benefit of training in management skills. Not all engineers can study management science at the graduate level. But every engineer should include in his professional reading as much as feasible of the excellent literature on this vital aspect of his life's work. A splendid annotated bibliography for use in this effort is to be found in the G.W.U. Book Store.³

In reflecting on the engineer of the future and the wide use he must make of his ability to manage, one can agree heartily with a quotation from Marshal Lyautey, the great Pro-Consul of France in North Africa (1926):

"He who is only a soldier is a bad soldier, he who is only a professor is a bad professor, he who is only an industrialist is a bad industrialist. The complete man who wants to fulfill his destiny and be worthy of leading men — in short, to be a chief — this man must have an open mind on everything that honors mankind."

²The term "industrial" will be used hereafter to designate all enterprises engaged in industrial, engineering, or scientific endeavor.

³Herbert E. Smith, *A Bibliographical Essay on Engineering Management* (Unpublished). Dr. Smith's essay is brought up to date periodically.



A career decision needn't be a headache.

Not if you apply facts as criteria in making your choice. And the facts that count are the "dimensions" of a company. *Where it's been . . . where it is today . . . and where it's going.*

Let's apply these measurements to Sikorsky Aircraft. First of all, we are an "engineer's" company. We earned that title during our early years of pioneering in a dynamic, young industry. Today, our trail-blazing assumes the form of the most advanced VTOL aircraft systems. Ultra-sophisticated vehicles . . . combining the challenging technologies of the *VTOL* airframe and complex electronic systems to create the world's most versatile means of transportation. As for tomorrow? Steady, solid advancement is a habit with us. And our programs for the exciting future ahead assure a most rewarding environment for young engineers who can keep pace with our growth.

WHERE WOULD YOU FIT IN? In any number of demanding areas. If you are an original thinker—an

innovator—you'll be asked to take on tough, responsible assignments. And you would be working in small, interdependent groups with some of the most respected engineers in the aerospace industry . . . helping to solve problems in such fields as **aerodynamics • human factors engineering • automatic controls • structures engineering • weight prediction • systems analysis • operations research • reliability/maintainability engineering • autonavigation systems • computer technology** . . . among others.

Are you our kind of engineer? Then the opportunity for individual recognition and growth is here . . . now.

And professional goals can be further advanced through our corporation-financed Graduate Education Program available in many outstanding schools within the area.

Please consult your College Placement Office for campus interview dates—or—for further information, write to Mr. Leo J. Shalvoy, Engineering Personnel.

Sikorsky Aircraft

STRATFORD, CONNECTICUT

An Equal Opportunity Employer (M & F)

**U
A**
DIVISION OF UNITED AIRCRAFT CORPORATION



Tom Huck sought scientific excitement



He's finding it at Western Electric

Ohio University conferred a B.S.E.E. degree on C. T. Huck in 1956. Tom knew of Western Electric's history of manufacturing development. He realized, too, that our personnel development program was expanding to meet tomorrow's demands.

After graduation, Tom immediately began to work on the development of electronic switching systems. Then, in 1958, Tom went to Bell Telephone Laboratories on a temporary assignment to help in the advancement of our national military capabilities. At their Whippany, New Jersey, labs, Tom worked with the Western Electric development team on computer circuitry for the Nike Zeus guidance system. Tom then moved on to a new assignment at Western Electric's Columbus, Ohio, Works. There, Tom is working on the development of testing circuitry for the memory phase

of electronic switching systems.

This constant challenge of the totally new, combined with advanced training and education opportunities, make a Western Electric career enjoyable, stimulating and fruitful. Thousands of young men will realize this in the next few years. How about you?

If responsibility and the challenge of the future appeal to you, and you have the qualifications we are looking for, talk with us. Opportunities for fast-moving careers exist now for electrical, mechanical and industrial engineers, and also for physical science, liberal arts and business majors. For more detailed information, get your copy of the Western Electric Career Opportunities booklet from your Placement Officer. And be sure to arrange for an interview when the Bell System recruiting team visits your campus.

Western Electric MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM
AN EQUAL OPPORTUNITY EMPLOYER



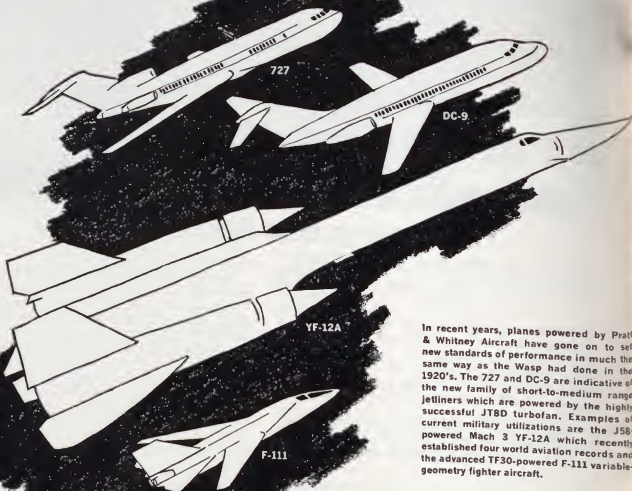
Principal manufacturing locations in 13 cities ☐ Operating centers in many of these same cities plus 36 others throughout the U.S.
Engineering Research Center, Princeton, N. J. ☐ Teletype Corp., Skokie, Ill., Little Rock, Ark. ☐ General Headquarters, New York City

Past



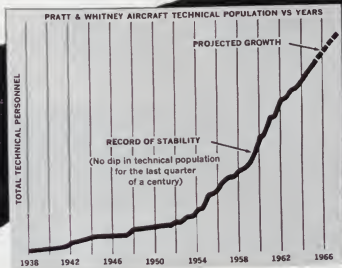
The Company's first engine, the Wasp, took to the air on May 5, 1926. Within a year the Wasp set its first world record and went on to smash existing records and set standards for both land and seaplanes for years to come, carrying airframes and pilots higher, farther, and faster than they had ever gone before.

Present



In recent years, planes powered by Pratt & Whitney Aircraft have gone on to set new standards of performance in much the same way as the Wasp had done in the 1920's. The 727 and DC-9 are indicative of the new family of short-to-medium range jetliners which are powered by the highly successful JT8D turbofan. Examples of current military utilizations are the J58-powered Mach 3 YF-12A which recently established four world aviation records and the advanced TF30-powered F-111 variable-geometry fighter aircraft.

Your and the Future



Take a look at the above chart; then a good long look at Pratt & Whitney Aircraft—where technical careers offer exciting growth, continuing challenge, and lasting stability—where engineers and scientists are recognized as the major reason for the Company's continued success.

Engineers and scientists at Pratt & Whitney Aircraft are today exploring the ever-broadening avenues of energy conversion for every environment . . . all opening up new avenues of exploration in every field of aerospace, marine and industrial power application. The technical staff working on these programs, backed by Management's determination to provide the best and most advanced facilities and scientific apparatus, has already given the Company a firm foothold in the current land, sea, air and space programs so vital to our country's future. The list of achievements amassed by our technical staff is a veritable list of firsts in the development of compact power plants, dating back to the first Wasp engine which lifted the United States to a position of world leadership in aviation. These engineering and scientific achievements have enabled the Company to obtain its current position of leader-

ship in fields such as gas turbines, liquid hydrogen technology and fuel cells.

Should you join us, you'll be assigned early responsibility. You'll find the spread of Pratt & Whitney Aircraft's programs requires virtually every technical talent. You'll find opportunities for professional growth further enhanced by our Corporation-financed Graduate Education Program. Your degree can be a BS, MS or PhD in:

**MECHANICAL • AERONAUTICAL • ELECTRICAL • CHEMICAL
ENGINEERING • PHYSICS • CHEMISTRY • METALLURGY
• CERAMICS • MATHEMATICS • ENGINEERING SCIENCE OR
APPLIED MECHANICS.**

For further information concerning a career with Pratt & Whitney Aircraft, consult your college placement officer—or write Mr. William L. Stoner, Engineering Department, Pratt & Whitney Aircraft, East Hartford, Connecticut 06108.

SPECIALISTS IN POWER...POWER FOR PROPULSION—POWER FOR AUXILIARY SYSTEMS. CURRENT UTILIZATIONS INCLUDE AIRCRAFT, MISSILES, SPACE VEHICLES, MARINE AND INDUSTRIAL APPLICATIONS.

Pratt & Whitney Aircraft

CONNECTICUT OPERATIONS EAST HARTFORD, CONNECTICUT
FLORIDA OPERATIONS WEST PALM BEACH, FLORIDA

**U
A**
DIVISION OF UNITED AIRCRAFT CORP.
An Equal Opportunity Employer



MECH MISS . . .

Miss Linda Larsen

This month's Mech Miss is Linda Larsen, the I.E.E.E. candidate for Engineer's Queen. Linda is a 19 year old sophomore from Arlington who is majoring in Mathematics.

Her activities on campus include two honoraries, the rushing chairman of Kappa Kappa Gamma sorority, and the president of Tossles.

Maybe she can lead I.E.E.E. on to bigger and better things.

For more information about this girl with a well rounded personality, you can solve the following cubic equation.

$$X^3 - 94X^2 + 2893X - 28980 = 0$$



FACULTY SPOTLIGHT

by Douglas L. Jones



The faculty spotlight this month shines on Francis J. Hughes, an Instructor in the School of Engineering and Applied Science. His educational background includes a degree of Bachelor of Science in Engineering Science from the University of Miami in 1960. In 1965 he received a Master of Science in Engineering in the area of Theoretical and Applied Mechanics from The George Washington University.

Professor Hughes has had professional experience with the National Security Agency and International Business Machines, Inc. He worked as a mathematician with a specialty in Numerical Analysis for N.S.A. from 1960 to 1962. He then worked as a Systems Analyst at I.B.M. from 1962 to 1963 at which time he received educational leave for graduate work at G.W.U. He has continued with the educational leave while pursuing doctoral work here. In addition, he is a Research Associate to Dr. Galys M. Arkilic on a research project in the general area of Solid State Physics. He has also done graduate work in Mathematics at The University of Maryland.

Professor Hughes' primary interest at the present is a career in corporate management. Although he is a native of Washington, D. C., he has travelled considerably and considers that one of his primary interests. Also he likes to keep active physically in such activities as football, swimming, and so forth.

Prof. Hughes' attitudes toward teaching indicate that the primary motivation for learning must come from the student. A teacher's purpose is to indicate the best direction to pursue in order to derive the greatest possible benefit from a course. Another primary objective is to help the student over the more difficult areas in the course material. He believes that a healthy attitude toward responsibility should be learned during the student's undergraduate experience so that he will be better prepared for graduate work or gainful employment. He also believes that students who show interest in a course should be encouraged to spend their time so as to derive maximum benefit from a course.

Prof. Hughes emphasizes the theory behind a course in the hope that the student will obtain a greater perspective of the subject matter. His feelings on this matter are exemplified by an excerpt from his remarks at the recent Sigma Tau Forum:

"I feel that it is important that scientific education should not only be subject to technological needs, but should also be concerned with the fact that scientific knowledge represents perhaps the most extraordinary intellectual achievement of the human race. The understanding of nature that is represented by science is something extremely valuable in itself and is great educational significance on its own merit."

EXPLORE THE UNIQUE OPPORTUNITIES AT

National Security Agency

...where special programs encourage rapid professional advancement for the engineer, scientist and mathematician launching his career.



NSA is a scientific and technological community unique in the United States, perhaps in the world. Unique in its mission, its operation, its requirements . . . unique, too, in the scope of opportunity it affords a young scientist or engineer beginning his career.

A separate agency functioning within the Department of Defense, NSA is responsible for developing "secure" (i.e., invulnerable) communications systems to transmit and receive vital information. Within this area, which encompasses the whole field of cryptology—the science of codes and ciphers—NSA project teams pursue a broad spectrum of investigations taking them well beyond many known and accepted boundaries of knowledge. Beginning with basic research, these investigations progress through applied research, development and design, prototype engineering, and on into various phases of applications engineering.

At NSA you might specialize in any or several of these sectors, depending on your talents and special interests:

ENGINEERING. Antenna/transmitter/receiver design . . . high speed computers (digital and analog) . . . transistor circuitry . . . advanced radio communications techniques . . . microwave communications . . . audio and video recording devices . . . cryogenic studies and applications . . . integrated circuitry . . . microminiaturization.

PHYSICS. Solid state (basic and applied) . . . electromagnetic propagation . . . upper atmosphere phenomena . . . superconductivity and cryogenics (Ph. D. graduates only).

MATHEMATICS. Statistical mathematics . . . matrix algebra . . . finite fields . . . probability . . . combinatorial analysis . . . programming and symbolic logic.

Unequaled Facilities and Equipment

In a near-academic atmosphere, NSA scientists and engineers enjoy the most fully-instru-

mented laboratories and use of advanced computer and other equipment, some found nowhere else in the world.

Skilled clerical and technical support will free you to concentrate on the most challenging aspects of your projects, and thus help speed your professional growth.

Outstanding Colleagues

You will work alongside people of enormously varied backgrounds and intellectual interests, over 500 of whom hold advanced degrees.

Researchers at NSA also receive constant stimulus from outside the agency. To assist in certain program areas, NSA often calls on special boards of consultants—outstanding scientists and engineers from industry and

of full-time graduate study at full salary. Nearly all academic costs are paid by NSA, whose proximity to seven universities offering a wealth of advanced courses and seminars is an additional asset.

IN-HOUSE TRAINING. The new NSA employee first attends a six-week general orientation program, followed by a period of specialized classroom study designed to broaden familiarity with an area or areas of heavy NSA concern (e.g., communications theory, cryptanalysis, computer logic and analysis, solid state physics). Formal study is complemented by on-the-job training, as you work and learn under the guidance and direction of highly experienced associates.

PROFESSIONAL ASSOCIATIONS, TRAVEL

The agency fosters a climate of recognition and advancement for its young professionals by encouraging participation in professional association affairs, and assisting you to attend national meetings, seminars and conferences as well as visit other research facilities where related work is underway—government, university and industrial—throughout the United States.

Liberal Personnel Policies, Attractive Location

NSA policies relating to vacations, insurance and retirement are fair and liberal. You enjoy the benefits of Federal employment without the necessity of Civil Service certification.

Located between Washington and Baltimore, NSA is also near the Chesapeake Bay, ocean beaches, ski resorts and other popular summer and winter recreation areas, not to mention the varied leisure-time attractions of the nation's capital itself. The location permits your choice of city, suburban or country living.

Campus Interviews— Check Now for Dates!

Representatives of the National Security Agency will conduct interviews on campus soon. Check with your Placement office as soon as possible to schedule an appointment.

nsa

NATIONAL SECURITY AGENCY

Suite 10, 4435 Wisconsin Avenue, N.W., Washington, D.C. 20016

An equal opportunity employer

...where imagination is the essential qualification



academic centers as well as from other government agencies.

Career Development Opportunities

Your professional growth and earning power expand from the day you join NSA, without having to accumulate years of "experience." NSA career development is orderly and swift; substantial salary increases follow as you assume more and more responsibility.

A number of NSA career development programs help shorten the time when you can contribute at your maximum potential. These programs include:

ADVANCED STUDY. NSA's liberal graduate study program affords you the opportunity to pursue part-time study up to eight hours each semester and/or one semester or more

You Have GOT To Be KIDDING

by Judith J. Popowsky

Judith Popowsky is one of the few distaff students to be successful in the School of Engineering and Applied Science. She expects to graduate in June of 1966 with a B.S.M.E., having been extremely active by holding all the major offices on the Engineers' Council and the Mechelectiv staff. She has also been active in IEEE and has been elected to Sigma Tau, Who's Who and several other honor societies.



"No, as a matter of fact, I'm not ... Yup, I really am ... G.W.U. ... A senior ... June, 1966 ... Mechanical ... Nepe. No joke ... I like it ... Um hm, just like that ... Do you want an ANSWER to that? ... All in one sentence?"

Sound peculiar? You should only hear the OTHER side!

"You have GOT to be KIDDING! ... You really ARE an engineer? ... What school? ... What year are you in? Freshman, Sophomore, ... ? ... A senior! Are you graduating in February? ... Which branch are you interested in? ... Mechanical, no less. No joke? ... Well, what on Earth ever made you decide on engineering, especially MECHANICAL engineering? ... Just like that. You like it ... Okay. Tell me this, then. How does it feel to be the only girl in your classes? ... Yeah ... Well"

Of course, it's not always the same. Reactions vary according to the individual. Some get slightly apoplectic, others just look at me kind of funny. I mean, they look at me ... long hair, teen-age pimples (currently receding), knee socks, sneakers (dirty white), female from the word "go" ... and, I rest the case it; I just don't meet the average man's concept of a typical engineer. So, I keep telling myself, "Maybe, in time, I'll be able to say, 'I am an engineer,' and whomever I'm talking to won't feel faint."

Now, let's get back to that last question. You know, the one on "how does it feel, etc." To put it all in one sentence, it's ... uh ... well, it's

..... Hmhmhm.

It's different!

My first class was fairly normal. The professor walks in, puts some papers on the table in front of him, stares at me, and politely murmurs, "Is everyone SURE he or she is in the right class?" I nod my head, and stare back. But my second class, now there was a mistake. I started through the door; one of the boys on the other side of the room abruptly turned around and faced the window; a joke, being told by some students to my immediate left, was stopped in midstream; someone who had just dropped a raft of papers on the floor interrupted his interpretation of the event with a sharp gulp. When the boy on the far side of the room had tucked in his shirt and straightened himself out, he turned around and sat down; when I was safely seated at least ten chairs from the joke, it was resumed ... in a deep, dark whisper; and, when I told the boy next to me that I really was an engineer, he quietly turned green.

Then, there was the first time I became an Old Man. You see, there exists on our campus two organizations of the big brother, older sister type, called, respectively, Old Men and Big Sis.

Junior and Senior men sign up for Old Men, which takes under its wing all incoming male students and assigns same to the guidance, aid, comfort, and general advice of one of the upperclass men. Similar arrangements are made between incoming female students and upperclass females. Now, the Engineers' Council, the student governing body of the School of Engineering and Applied Science, chose two years ago to begin a similar program for incoming engineering students only, with members of the Council assuming the functions of Old Men. Naturally, as a member in good standing of the Engineers' Council, I volunteered.

There were two very interesting results of said action. The first came when the members of the Council decided it would be appropriate for them and their fledglings to attend the Old Men Mixer, a social function designed to acquaint all incoming freshmen males with the many organizations, etc., open to them on campus. We all agreed it would do our "little sons" some good to see what the rest of the campus was up to, so off we went. All went well, until I entered the room. Needless to say, the young gentleman signing in all the Old Men, and their underlings, was a bit perturbed. He didn't quite know what to do with me. Well, it seemed to me to be a fairly easy problem to solve. Only Old Men could be in charge of male freshmen, and I was in charge of nine such organisms, so I must be an Old Man. Right? Right! And my "sons" were delighted! They had a very conspicuous Old Man. Every-body knew who their Old Man was.

And this is what brought about a second most interesting result. One of my freshmen went home and told his mother about me. Now, be serious. What would YOU think if your son, fresh out of high school, entering into the rigorous study of engineering, came home from a seemingly harmless social type function and calmly announced, "Judith J. Popowsky is my Old Man?"

Of course, there are some aspects of being in engineering that cannot be compared to being in any other curriculum. One such is my being the only girl in my classes since my sophomore year (engineering classes, that is).

The first time it happened, I was, I will admit, treated pretty much as an outsider by those who hadn't seen me before. Some of them had, through the organizations I had entered in my freshman year, and through the classes I had taken. But most of them had not, so they didn't know what to make of me. It took a few weeks for them to stop staring, and then they didn't pay any attention to me at all. This was when I began being treated as a student in engineering, instead of as a girl in engineering. And that's the way it has been. In class, I'm just another student, no different than the rest of the students trying like mad to figure out the garble being thrown at us by the prof's.

CAMPUS NEWS

by Doug Lowe

"JUST WAIT TILL NEXT SEMESTER"?

Time is rapidly running out. In about a month the professors are going to find out just how much we have learned this semester. Conceivably, they could be pleasantly surprised. Hopefully, they will be satisfied. Realistically, they will be disheartened.

Whatever the reasons may be, we generally do not give our maximum effort in this 140 credit endeavor to build a good foundation for later professional success. What our performance should be and what it actually is often differ markedly. After all, it is very difficult to remain determined and inspired every semester for four, five, or six years when the only real incentive to study is the one provided by our own desires.

The Engineers' Council, the professional and honorary societies, and Theta Tau professional fraternity have realized this fact. Individually, these groups strive to do things which are worthwhile for their members. Now they are pooling

their resources for work on the February Engineers Week Open House in the hope that the common effort will in itself be beneficial to those directly participating and that the over-all event will serve to show all who observe it that diligent college studies are important and are directly related to professional work later.

When Engineers Week does arrive, when the displays are in the halls, when the pamphlets are there for the taking, when the professionals are doing the talking, don't be hesitant: look around, listen carefully, try to find an idea or a thought which will renew your inspiration and determination. The time you spend will not be wasted. Perhaps the professors will indeed be pleasantly surprised when the spring semester finals are over.

Better yet, be a participant and not just a spectator. Work through your society or contact Doug Lowe at 333-3515.



TAU BETA PI

by Douglas MacDonald

Tau Beta Pi's 60th National Convention was held in College Park, Maryland, October 13-16, 1965. The Maryland Beta (University of Maryland) collegiate chapter was host. Headquarters for the Convention was the University of Maryland Center of Adult Education.

The collegiate chapters of Tau Beta Pi were represented by delegates and alternates from 114 of America's leading engineering colleges and universities. The delegate from George Washington University was Douglas MacDonald, president of the District of Columbia Gamma Chapter of Tau Beta Pi.

At the 1965 Convention welcoming dinner on the evening of October 13, J. Kent Haspert, chairman of the host chapter's arrangements committee, Joseph R. Crupi, president of the Maryland Beta Chapter, and Professor Russell B. Allen, acting dean of engineering at the University of Maryland, graciously welcomed the Convention on behalf of the host chapter and the host institution. Dr. Donald S. Clark, President of Tau Beta Pi, responded to their welcomes on behalf of the Convention. Mr. Bastian Hello, director of lifting body programs for The Martin Company, spoke on the subject of "Our Manned Space Flight Program" at the Conventions October 14th dinner meeting. The Honorable Dr. Weston E. Vivian, U.S. Representative from Michigan and the only engineer in Congress with a doctor's degree, spoke at the October 15th dinner meeting. His topic was one upon which he is uniquely

qualified to speak, "An Engineer's Role in the United States Economy."

A major event of the Convention was the formal initiation ceremony on October 15. It was conducted by a team of national officers of Tau Beta Pi under the leadership of President Donald S. Clark. A member of the team was Secretary-Emeritus Matthews who retired in 1947 but who continues to take a great interest in the organization and is an inspiration to all members. The initiates included students of the Maryland Beta host chapter, and students of the nearby District of Columbia Alpha (Howard University) and District of Columbia Gamma (George Washington University) chapters. The District of Columbia Gamma Chapter initiates were: Paul B. Johnson and William A. Rutizer.

Announcement of the Tau Beta Pi's Outstanding Chapter Awards for 1964-65, the chapters which did most to advance the Association's goals of recognizing distinguished scholarship and exemplary character and fostering a spirit of liberal culture in engineering colleges during the year, was made at the initiation banquet by President Donald S. Clark. The top award went to the host chapter, Maryland Beta, and was a most fitting conclusion to the chapter's year of preparation for the Convention.

Tau Beta Pi is the National engineering honor society now having 120 collegiate chapters, 31 alumnus chapters, and over 130,000 initiated members. Students are elected to membership by the chapters from the top 20 per cent, scholastically, of their engineering classes on the basis of their character. Alumni may be elected on the basis of their eminent achievements in the engineering profession.

THETA TAU



(Chip Young, Regent and Bruce Howard,
Engineers' Council President in Conference)

THETA TAU AT WORK

THETA TAU AT PLAY ...



THETA TAU AT NIGHT ...



DOUG CAVES, SALESMAN
C.E., '61, University of Southern California



BOB FROST, PLATE MILL FOREMAN
I.E., '62, Penn State University

Men on the move

at Bethlehem Steel



DENNIS WITMER, RESEARCH ENGINEER
Ch.E., '61, University of Maryland



DOM TORIELLO, OPEN-HEARTH FOREMAN
Mt.E., '63, Case Institute of Technology



DON SIGMUND, ELECTRICAL ENGINEER
E.E., '62 Carnegie Institute of Technology



KARL KUGLER, MECHANICAL ENGINEER
M.E., '62, State University of New York (Buffalo)

Have you heard about all the opportunities for engineering and other technical graduates at Bethlehem Steel? You'll find a great deal more information in our booklet, "Careers with Bethlehem Steel and the Loop Course." You can obtain a copy at your Placement Office, or drop a postcard to Manager of Personnel, Bethlehem Steel Corporation, Bethlehem, Pa. 18016.

An equal opportunity employer in the Plans for Progress Program

When? December 11, 1965 - 9 P.M. to 1 A.M.
Where? Woodner Hotel, 3636 16th St., N. W.
How? \$5.00 Per Couple - BYOL



Inside Front Cover	Westinghouse Electric Corp.
1	National Cash Register Co.
2	United States Army
3	American Oil Company
7	Xerox Corporation
10	Sikorsky Aircraft
11	Motorola, Inc.
15	Western Electric Company
16 & 17	Pratt & Whitney Aircraft
22	Melpar, Inc.
24	Raff Analytic Study Associates
26	National Security Agency
30	Bethlehem Steel Company
31	The Asphalt Institute
Inside Back Cover	Eastman Kodak Company
Outside Back Cover	General Electric Company



Prepare now for your future in highway engineering...get the facts on The Asphalt Institute's new computer-derived method for determining structural design of Asphalt pavements for roads and streets

Today, as more and more states turn to modern Deep-Strength* Asphalt pavement for their heavy-duty highways, county and local roads, there is a growing demand for engineers with a solid background in the fundamentals of Asphalt technology and construction.

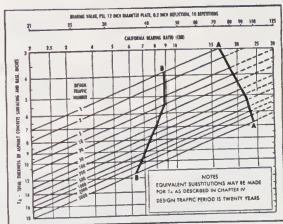
Help to prepare yourself now for this challenging future by getting the latest information on the new Thickness Design Method developed by The Asphalt Institute. Based on extensive statistical evaluations performed on the IBM 1620 and the mammoth IBM 7090 computers, accurate procedures for determining road and street structural requirements have been developed.

All the facts on this new method are contained in The Asphalt Institute's Thickness Design manual (MS-1). This helpful manual and much other valuable information are included in the free student library on Asphalt construction and technology now offered by The Asphalt Institute. Write us today.

*Asphalt Surface on Asphalt Base

THE ASPHALT INSTITUTE

College Park, Maryland



Thickness Design Charts like this (from the MS-1 manual) are used in this new computer-derived method. This chart enables the design engineer quickly to determine the over-all Asphalt pavement thickness required, based on projected traffic weight and known soil conditions.

THE ASPHALT INSTITUTE
College Park, Maryland

Please send me your free student library on Asphalt construction and technology, including full details on your new Thickness Design Method.

Name _____ Class _____
School _____
Address _____
City _____ State _____

THE

SHAFT



GIRLS . . . BEWARE THE ENGINEER!

Verily I say unto you, beware the engineer; for the engineer is a strange animal possessed by many devices; yea, he speaketh in parables which he calleth formulae; he wieldeth a big stick which he calleth a slide rule; he hath but one Bible -- a handbook.

Always he carrieth books with him, and he entertaineth his maiden with steam tables and nomographs. Verily though the damsel expecteth chocolates, when he calleth, he opens the package to reveal samples of a new alloy.

Yea, he holdeth a damsel's hand but only to measure the friction, and he kisseth only to test viscosity. For in his eye shineth a faraway look which is neither love nor longing, but a vain attempt to remember an equation.

Even as a little boy, he pulleth a girl's hair, but to test its elasticity and as a man he discovereth different devices, for he would hold a maiden to his bosom only to measure the frequency of the palpitations of her heart, and to determine the strength of her materials.

Alas, however, his affairs are a series of simultaneous equations, involving two unknowns, seldom approaching a steady state, and yielding only periodic functions.

Know the difference between the mambo and pea green paint? Anybody can mambo.

A woman got on the train with three sets of twins. When the conductor came by for the tickets he looked at them in astonishment. "Do you mean to say you get twins everytime?" he asked.

"Oh, no," she replied. "Hundreds of times we don't get anything."

If you don't think women are explosive, try dropping one.

ENGINEER'S CHANT

Keep on studying, get no sleep,
Soon you're looking like a creep,
Coffee flows, aspirin too,
Seems your eyes are full of glue,
Stress and strain, calculus,
Find unknowns, must not fuss,
Temper short, walk with droop,
Keep on feeling like a stupe,
Paper spread upon the floor
"Quiet Please" pinned on the door,

Books are stacked in towering pile,
Wonder if it's worth the while.
Toss a coin, decide the crams,
Heads, the Army; tails, exams.

Engineer: "Going around with women a lot keeps you young."
Second Engineer: "How come?"

Engineer: "I started going around with women when I was a freshman two years ago, and I'm still a freshman."

One way to tell the difference between male and female chromosomes is to take down their genes.

A young man contemplating matrimony wanted to propose and didn't know how, so he went to his dad for advice.

"Well, son," said the old man, "I don't know that I can help you much. With me and your Maw it happened one Sunday evening, when yer Maw and me was a sitin' on the sofa. We was just a talkin' along and purty soon yer Maw leaned over and whispered in my ear and I said, 'The hell you are,' and the next day we were married."

Then there was the groom who finished his wife's first breakfast, muttering, "Can't cook either."

An M.E. we know broke his arm fighting for a woman's honor. It seems that she wanted to keep it.

The high quality of Swiss craftsmanship is legendary. In the early days of American watchmaking, a Connecticut firm succeeded in making a shaft only one-thousandths of an inch in diameter, about half the thickness of a human hair. After patting themselves on the back for some time, the Americans sent the shaft off to a firm of Swiss watchmakers for their comments. Back came the shaft without comment--but with a hole drilled through it!

A college football coach was surprised to see a busty coed wearing a varsity sweater. Stopping the girl, he growled:

"What are you doing with a letter sweater? Don't you know you're not supposed to wear one unless you've made the team?"
The coed smiled, then cooed, "WELL?"

An automobile dealer who doesn't enjoy a good reputation advertised that he would give away a blonde with each car. A delighted young wolf bought a car and rode with his newly-won blonde into the country and parked. He kissed her, and then whispered in her ear. "No," she replied, "you got that when you bought the car."

"Some girls are cold sober--others are always cold."

In days of old, when told a naughty story, the coed would blush. Nowadays she memorizes it.

A modern country is one which can ban fireworks and produce H-bombs.

You're only young once, but if you work it right, once is enough.

A snowflake in an avalanche never feels responsible.

We were a famous camera and film manufacturer

After World War I we diversified. It went very well. Now we are part and parcel of hundreds of other industries from the aerospace industry to the spaghetti industry, from the drapery business to the computer business. In cameras and film we continue to do better than ever—much, much better.

Nevertheless we worry. Could we be more effectively applying our technologies in the 1970's and the 1980's and the 1990's to problems that mankind is not at present solving satisfactorily? We are about to hire the smart technical and administrative people who will answer that question and still be personally involved in the 1990's. They will start by learning our present technologies as a base for new ones. They will be well paid to learn because they will be useful to us while learning. Those who learn more will get paid more, which is a good reason never to stop learning.

Here is your chance. Drop us a line to get acquainted.

We tend to let the people themselves decide how rigidly to separate mechanical engineering, chemical engineering, chemistry, physics, electronic engineering, and the many other useful disciplines they bring with them.



EASTMAN KODAK COMPANY

Business and Technical Personnel Department / Rochester, N. Y. 14650

An equal-opportunity employer offering a choice of three communities: Rochester, N. Y., Kingsport, Tenn., and Longview, Tex.

Kodak



ONE RESULT of product innovation is G.E.'s modern manufacturing facility in Brockport, N. Y.



OUTPUT VOLTAGES from nickel-cadmium cells are examined by engineer John Bliven, BSEE, Union College '63 on assignment at G.E.'s Battery Business Section.



PRODUCT RELIABILITY of electric slicing knife components is the responsibility of Mike Reynolds, BSME, New Mexico State, a recent Manufacturing Training Program graduate.



PRICE AND DELIVERY information on nickel-cadmium batteries is supplied by Bob Cook, BSME, Univ. of Florida '65 on a Technical Marketing Program assignment in Gainesville.

A PREVIEW OF YOUR CAREER AT GENERAL ELECTRIC:

Creating New Growth Businesses

At our Brockport, N. Y., plant, the new business of manufacturing cordless slicing knives is **rush**. So is that of the rechargeable-battery supplier, our two-year-old plant at Gainesville, Fla., which has just doubled its working area. Its sealed, nickel-cadmium batteries, in hundreds of shapes, sizes and ratings, are meeting growing customer demands in the consumer, defense, and aerospace industries—with applications from power tools to satellites. At General Electric, new ventures are a way of life. In both their formative and growth stages, these ventures call on the skills and

enthusiasms of experts in more than 120 product departments—in engineering, manufacturing and technical marketing. To define your career interest at General Electric, talk with your placement officer, or write us now. Section 699-15, Schenectady, N. Y. An Equal Opportunity Employer.

Progress Is Our Most Important Product

GENERAL  ELECTRIC